NOVEMBER 1968

USGA GREEN SECTION RECORD

A Publication on Turf Management
by the United States Golf Association

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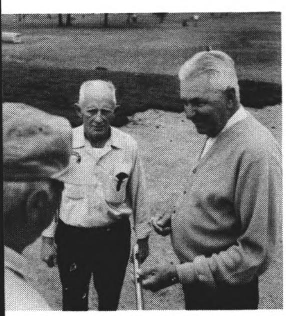
VOL. 6, No. 4 **NOVEMBER 1968**



COVER PHOTO: Since 1951, the Green Section Visiting Service Program has been concerned with direct visits to USGA member clubs. One of the first clubs to subscribe to this service was Recreation Park Golf Club, Long Beach, Calif., and here B. K. Jones and Ivan Rousey, staff members at the course, participate in a visit by their Green Section representative.

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Editor: William H. Bengeyfield **Managing Editor: Robert Sommers**

Reorganization Moves Green Section Ahead

Evolution is as important to an organization as it is to an organism. Change and progress are synonymous with growth. Next year the Green Section will once again evolve and will have a new look.

After completing a survey of its Member Clubs, the Green Section Committee and the USGA Executive Committee decided to set new dimensions for the Green Section. Henry H. Russell, USGA Green Section Committee Chairman put it this way:

> "Reorganization is an absolute necessity if the Green Section is to keep pace with the growth of golf in this country and the increase in USGA membership. Reorganization will improve the Green Section's efficiency, will provide better service to subscribers to our Visiting Service, and because of the increased staff, will enable the Green Section to add new subscribers. There will be an increase in its total volume of work."

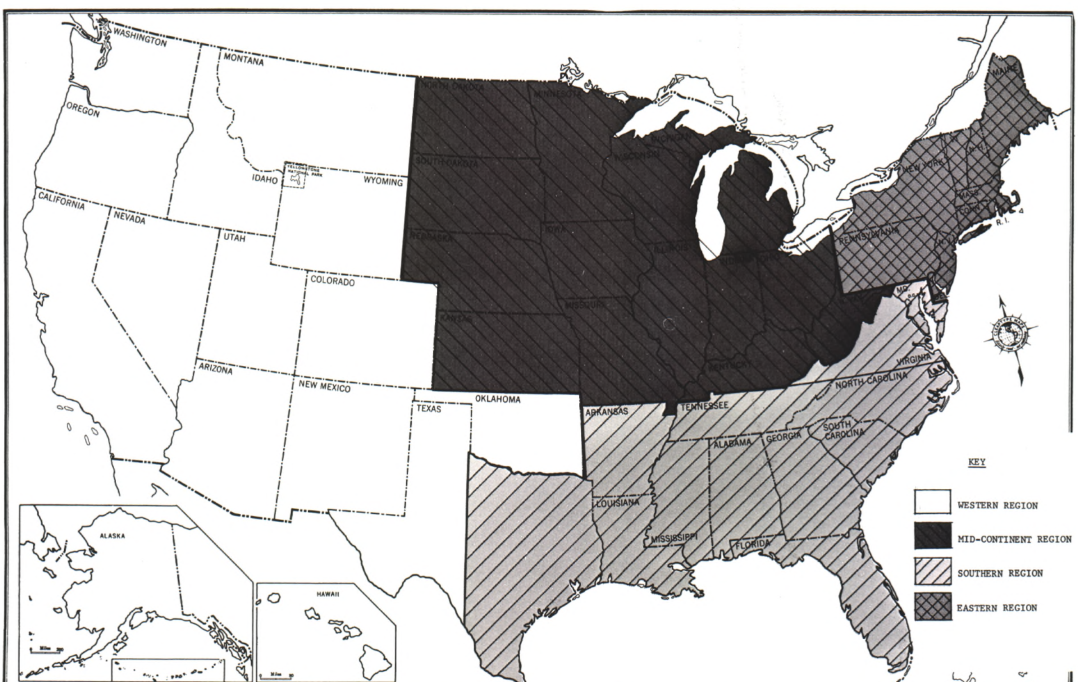
To serve subscribers better, some Regional Offices have been relocated and new staff members added. The intention was to place each office close to the numerical center of each region's Visiting Service subscribers. In addition, the work load for staff members has been better distributed, and subscribers will receive even better service in the years ahead.

Mid-Continent Region

The Green Section Mid-Continent office will now be located at 211 East Chicago Avenue, Chicago, Ill. James L. Holmes is Mid-Continent Director. He will team with F. Lee Record, Mid-Continent Agronomist, and together they will visit subscribers in North Dakota, South Dakota, Nebraska, Kansas, Ohio, West Virginia, Kentucky, Indiana, Illinois, Wisconsin, Michigan, Minnesota, Iowa and Missouri.

Southern Region

A new regional office for the Green Section has been established in Athens, Ga. The new Southern Director is James B. Moncrief, who has been with the Green Section for over 13 years. The address is Box 4213, Campus Station, Athens, Ga. 30601. His associate is Holman M. Griffin, Southern Agronomist. They will cover Visiting Service subscribers in Arkansas, East Texas, Louisiana, Mississippi, Florida, Alabama, Georgia, South Carolina, North Carolina, Tennessee, Virginia, and Maryland.



JAMES B. MONCRIEF *F. LEE RECORD* *ALEXANDER M. RADKO*

Eastern Region

Alexander M. Radko continues as the Eastern Regional Director, and now assumes the additional duties of National Research Director. He will be assisted by Robert Mazur and James W. Timmerman, Eastern Agronomists. They may be reached at Box 1237, Highland Park, N.J. 08904. Their territory covers Maine, Vermont, New Hampshire, Rhode Island, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania and Delaware.

Western Region

The largest territory of the Green Section (if you include the Pacific Ocean) lies in the Western Region. William H. Bengeyfield is the Regional Director and has recently become the Green Section Publications Editor. His coworker is Duane Orullian, Western Agronomist. Together they will serve member clubs from the Rocky Mountain states west to Hawaii. Their office is Box 567, Garden Grove, Calif. 92642.

New Emphasis on Research

With the reorganization of the Green Section, it is the USGA's intention immediately to increase its support of turfgrass research activities. Al Radko will head this important program. It is recognized that substantial support for specific projects is needed, and we intend to fill that need. Indeed, research has always been at the foundation of Green Section work. That base will now be strengthened, improved and revitalized. Maintaining the status-quo, is not good enough for today. It is time to move on to new information, to develop new concepts for the future. This is our goal.

Service—The Green Section's Only Mission

A total of 917 courses subscribed to the Visiting Service Program in 1967, and 1,339 direct visits and written reports were made by Green Section agronomists to the subscribers. The organization has now been geared for expansion; both in research and consultation activities.

For an annual fee of $225 (for an 18-hole course), any USGA Member Club can avail itself of these significant services. The hand of the golf course superintendent and Green Committee Chairman is strengthened by direct visits of agronomists who know golf course requirements. Unbiased recommendations, interpreted research information, and an exchange of turf management techniques is the end product of each visit and report.

The program has proven itself over the years. The number of supporting clubs continues to increase, and indeed, has necessi-

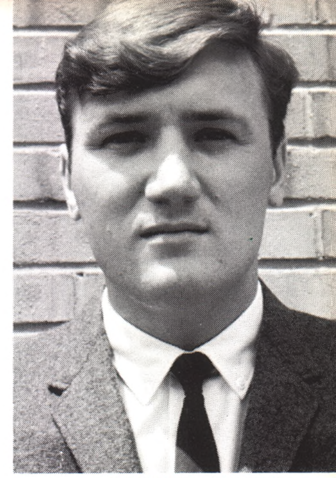
JAMES L. HOLMES *HOLMAN M. GRIFFIN* *WILLIAM H. BENGEYFIELD*

HENRY H. RUSSELL

JAMES W. TIMMERMAN

G. DUANE ORULLIAN



A. ROBERT MAZUR

tated the present expansion. If your club does not now receive the Visiting Service, it may well be worth considering. No one has a monopoly on knowledge. Evolution, like time, never ceases.

Brief Biographies of Newest Green Section Staff Members

A. Robert Mazur

Born in Middletown, Conn., and moved shortly thereafter to North Kingstown, R.I. Graduated from the University of Rhode Island in June, 1963, with a B.S. in agricultural chemistry.

Received a commission in the United States Army and served two years as a supply officer at Ft. Ord, Calif.

Returned to graduate school in January, 1966, at the University of Rhode Island. Conducted research on turfgrass primarily in the area of weed control. Received M.S. from the University of Rhode Island in June 1968.

Began work for the USGA Green Section in March, 1968.

Has written several publications on weed control in turfgrass.

Member of American Society of Agronomy, Alpha Zeta, Phi Sigma, and Sigma Xi.

G. Duane Orullian

Born and raised in Idaho Falls, Idaho. Father has been the professional at Pinecrest Golf Club for 33 years.

Attended Utah State University and graduated with a B.S. in Entomology in 1959. Later returned for post graduate work, which he hopes to complete in the near future.

1961-1962 Health Physics Technician at National Reactor Testing Station near Arco, Idaho, by Phillips Petroleum Company.

1962-1964 Assistant Territory Manager for the Niagara Chemical Division of FMC Corp. in Yakima, Washington.

1965 Employed by Yakima Farmer's Supply Company in Yakima, Washington as a Field Entomologist.

1965-1968 Employed by American Oil Co. as Farm Advisor in Yakima, Washington for 1 ½ years; then as Pesticide Formulating Plant Manager at Twin Falls, Idaho and last year as Farm Advisor at Blackfoot Farm Center in Idaho.

Holds a 10-year membership in the Entomological Society of America as well as a life membership in the Sigma Alpha Epsilon fraternity.

James W. Timmerman

Born October 8, 1938, in Monona, Ia. Reared on poultry and crops farm in Howell, Mich.

B.S., 1964, Michigan State University, Soil Science, (Turf).

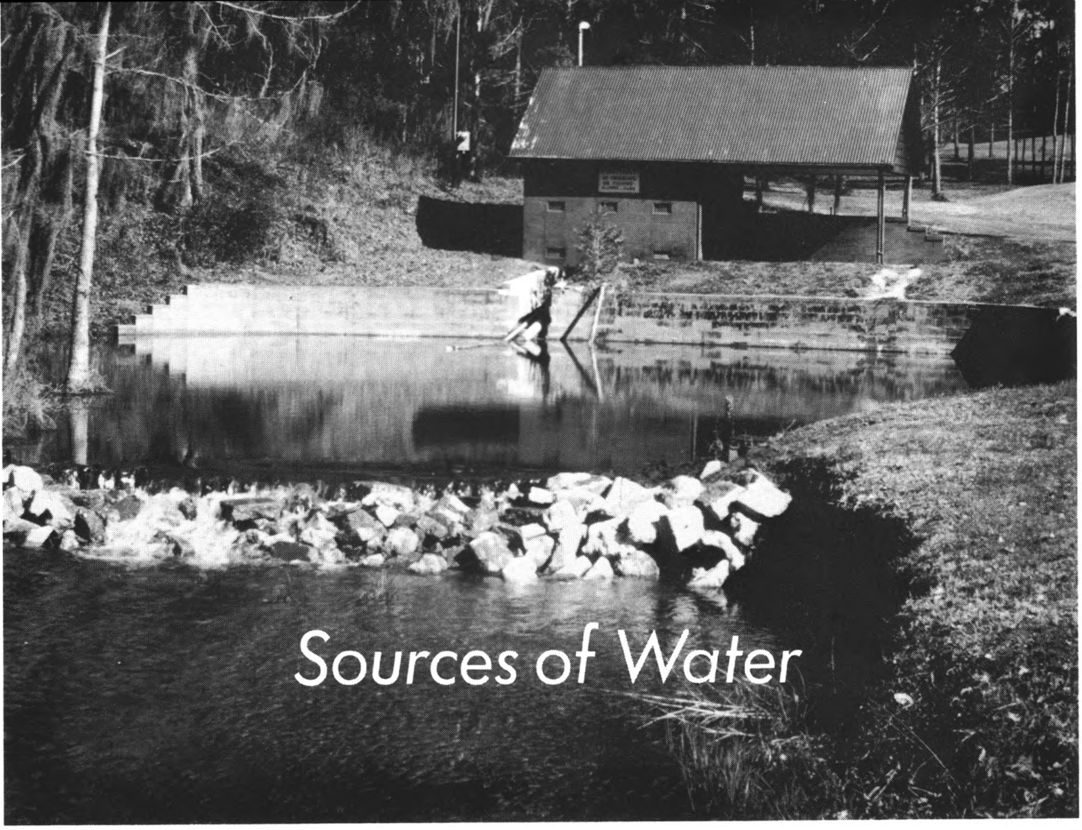
M.S., 1968, Michigan State University, Soil Science, (Turf).

1964-1968, Graduate Assistant, Michigan State University, research in turf.

1964-1966, Assistant Superintendent, Westwood Country Club, Buffalo, N.Y.; supervision of golf course; March-October 1964, Detroit Golf Club, section man, maintenance of golf course; March 1963-September 1963, Walnut Hills Country Club, E. Lansing, Mich., section man, maintenance of golf course; USGA Green Section, April 1, 1968.

Member of American Society of Agronomy, Soil Science of America.

Veteran (army); married.



Sources of Water

by JAMES B. MONCRIEF, Southern Director, USGA Green Section

Rainfall is the original source of water. Records show that in Georgia we normally get enough rainfall in one year to cover the entire state to a depth of four feet. This is over one million gallons per acre. In some of the southwestern states it takes several years to receive this much water.

About 80 percent of the annual precipitation in Georgia returns to the atmosphere through evaporation from plant and soil surfaces and transpiration by plants. Most hydrologists often call this the total evapotranspiration. The remaining 20 per cent runs off the surface as immediate streamflow, or enters the soil and moves to the groundwater where it is available for pumping, or later returns as base flow in the streams.

Where a dense sod covers the land, less rain (2-3 per cent) leaves as surface water whereas on cultivated soil a high percentage of the water leaves as surface runoff. The type of soil will have much influence on loss of water by surface runoff.

Ponds, lakes, or reservoirs are important sources of water for industry, municipalities, and recreation. Groundwater has been used for thousands of years, and streams, springs, and wells no doubt were the first ground water sources used. Archeology of pre-historic people indicates that irrigation, or the application of water to lands by artificial methods, is a very old practice. Evidence points to Egypt as its place of origin. Ancient Egyptian paintings and sculptures show that water was bailed up for watering crops at least 4,000 years ago.

Modern irrigation was begun in the United States in 1847 by pioneers of Salt Lake Valley, Utah. Since that time, the practice has spread first into the richer and warmer valleys, and then generally throughout the arid part of the West. Golf courses are now being irrigated throughout the continental United States. Skinner Irrigation Co. was one of the first to design a sprinkler irrigation system in 1896.

There are seven principal methods of applying water to land:

1. Flooding—running water over a smooth field surface.
2. Furrow—applying water in furrows.
3. Check method—pooling water succes-

sively into checks or rather large pools or squares into which the fields may be divided.

4. Basin—similar to the check method except that the basins are smaller. This type is used primarily in orchards.
5. Border method—flood irrigation between controlling borders or ridges.
6. Sub-irrigation water below the surface accomplished by means of open drainage ditches and underground basins.
7. Sprinkler irrigation—application of water under pressure in pipes so that it comes through whirling sprinkler heads as a spray.

Most old, established courses of today are thinking of installing irrigation systems of some sort if they have not already done so. There are a few areas where precipitation is sufficient enough and irrigation is rarely needed. Such an area is Highlands, N.C., with a 36-year average of 82.63 inches annual rainfall, and Skamania County near Cougar, Wash., for an 11-year average of 117 inches annual rainfall. At the other end of the rainfall average is Agua Caliente, Ariz., with an 11-year average of 2.98 inches of rain per year.

Hydrology

In the middle ages, people believed that water in rivers flowed magically from the center of the earth. Late in the 17th Century, Edmund Halley, the famous English astronomer, calculated the amount of water flowing in rivers that empty into the Mediterranean Sea and found that their flow is about equal to the water falling in rain and snow on the area drained by the rivers. At about the same time, two Frenchmen arrived at the same conclusion.

Water is constantly being exchanged between the earth and the atmosphere. This exchange is accomplished by the heat of the sun and the pull of gravity. Water evaporates from wet ground, from the leaves of growing plants, and from lakes and reservoirs and is carried in the air as water vapor. When water vapor condenses, it changes from a gas to a liquid and falls as rain. The rain feeds the rivers and lakes, and the water is carried to the ocean by rivers. The water goes from earth to atmosphere to earth again and again. This process is called the hydrologic cycle. Hydrology is the study or knowledge of water. Hydro means having to do with water, and loge is a Greek word meaning "knowledge of."

Water in the Ground

Have you ever wondered where the water comes from which flows merrily along with not a cloud in the sky? Where has it been all the time?

One of the principal methods of applying water to turf.

Windmills are used to pump fresh water from top of saltwater.

In brief, it has been in the ground!

It is interesting to know how it got into the ground, how it moves from where it entered the ground to the place where it gets into the streams or rivers, and how long this takes.

You might compare the soil surface to a sieve. Water enters the soil and works its way down into cracks, crevices, and holes into larger cavities. On coarse sand or gravel there is fast movement into the earth. However, when rain falls on clay or fine-grained soils, the passage downward is slow and water may run off the surface. The water going into the soil is called infiltration.

Two forces are involved in the movement of water within the soil: capillarity and gravity. Capillarity can work both upward and downward where small particles are close enough together, very similar to cloth used as a lantern wick. When the soil strata are coarse, the water is pulled by gravity and flows downward more or less freely through the spaces. Similarly, water may flow downward through holes made by aerification, worms, or where roots decay. The water continues to move through various layers of soil, rocks, in caverns, gravel strata and from underground streams or lakes.

One of the deepest oil wells ever drilled is about 25,000 feet. This is almost 5 miles. Although this is deep, it is insignificant compared to 4,000 miles to the center of the earth. This well has penetrated deeper than the ordinary cracks found in the near surface rocks.

The soil or rock which contains or transmits water and is a source of underground water is known as an aquifer. An aquifer is an underground zone layer which is a relatively good source of water. Water can move from aquifer to aquifer, and the amount of water obtained can vary tremendously. One of the largest underground fresh water sources in the United States is in the north portion of Florida.

As water passes through different strata, it can collect minerals that affect its taste, color, or odor, and this can vary a great deal within a short distance. How long does it take water to move in the soil? Anywhere from a few feet per year to a few feet per day.

It may take hundreds of years for water to travel 20 miles, while in some areas the same distance may have taken months or a few years. In some of the arid parts of western United States water is being pumped that fell as rain during the ice age, or at least

10,000 years ago. Water being pumped from a well could have been stored underground for months, years, or centuries. If the water is pumped out faster than inflow to the storage basin, there is a lowering of the water table, but when the inflow equals the outflow, there is no change in the amount of storage water.

There are many places in the United States where the water levels are progressively going down because of overdrafts on the ground water supply. One such area is the Gila River Valley of Arizona; another is the high plains of northwest Texas.

Chemicals in Water

As water filters through various strata, chemistry can become complex. Rainwater usually contains less than 10 parts per 1 million of dissolved matter, or 1 million pounds of water contains 10 pounds of dissolved material. The dissolved material in rivers is usually less than 500 ppm, but some may contain 2,000 or more ppm. Most city water is less than 500 ppm, and any over this is considered undesirable. Brine water will contain as much as 10,000 ppm and is much too salty for use. Sea water contains about 35,000 ppm. The Great Salt Lake contains about 250,000 ppm.

Water from some areas of the shallow coastal plain aquifers of the late Pleistocene age generally is low in dissolved solids. In some areas, this water source also has a disagreeable odor caused by hydrogen sulfide. It may have a high iron content as well and is usually classified as hard water.

Silver Springs, near Ocala, Fla., has a flow of 500 million gallons of water per 24 hours and removes about 600 tons of dissolved solids (mostly calcium bicarbonate) per day.

Shallow water from dune sand along the coast in South Carolina is usually hard and contains dissolved solids. The water becomes softer because of base exchange in which calcium and magnesium ions are replaced by sodium ions resulting in sodium bicarbonate water having a pH of about 7.7 to 8.7. The base exchange has not been definetely identified, but a likely one is the glauconite, which occurs in formation of the Peedee and Black Creek of South Carolina. Another base exchange material in the coastal area is the clay mineral montmorillonite.

This gives some of the chemical reactions that can take place while water is in the ground. In other areas, you may find other chemicals in your source of water.

Unfortunately many golf courses are being built today without knowledge of the type of water available for irrigation purposes. Before considering any other factor in an improved irrigation system for your golf course, check on the availability, the purity and the amount of water you are going to require. Check your "water sources" first!

Good streams and ponds can add to the beauty of a golf course and to the members' enjoyment.

The Fate of Herbicides

by A. ROBERT MAZUR, Agronomist, USGA Green Section

With the widespread and repeated use of chemicals for the control of weeds in turfgrass, several questions often arise:

(1) What happens to the herbicides we apply year after year?

(2) How often can we apply these materials without apparent injury to the turfgrass?

(3) What effect does the long term use of these materials have on established turf and the establishment of new seedings?

(4) What can we do to modify any deleterious effects which may occur?

In general, herbicides may disappear from the soil in three ways: by chemical means such as hydrolysis, oxidation, and photodecomposition; by physical means, such as volitilization, leaching and absorption; and by biological degradation.

Under field conditions, rate of application, type of soil, nature of the material, weather, and cultural practices all have a direct bearing on the life of herbicides in the soil.

Microorganisms

The single most important factor leading to the breakdown of herbicides is soil microorganisms. Biological degradation is hastened by those factors favoring the activity of the soil microorganisms. Environmental factors such as temperature, moisture, oxygen supply and organic matter content determine the rate at which biological decomposition takes place. The optimum temperature range for most soil organisms is between 75 and 90°F.

The principal microorganisms in the soil are algae, fungi, actinomyces and bacteria. As the pH of the soil varies, the activity of certain groups of organisms is enhanced and others is retarded. Bacteria and actinomyces are favored by pH's above 7.0 while fungi are most active at pH's below 5.5. The pH, however, seems to have little effect on the total microbial population. Those microorganisms most favored by conditions increase rapidly, and therefore the population is in a constant state of fluctuation.

It has been shown that organic soils require higher application rates of herbicides for effective weed control than mineral soils. The larger microorganism population and the greater degree of internal surface area have been found to be responsible for this reduction in activity.

Enzymatic capabilities of microorganisms are wide and varied; however, soil microorganisms are not infallible. Although resistance to biological decomposition means a greater period of weed control, it also presents the potential hazard of residue accumulation following repeated use. The resistance of organic materials to decomposition is evidenced by the present accumulation of detergents in drinking water sources. This should be a caution to us on the use of our turfgrass herbicides in excess.

Chemical Breakdown

The nature and properties of chemicals affect such characteristics as vapor pressure, water solubility, and melting point, which are all important factors in determining the length of time that the herbicide will be effective in the soil. Those materials which are volatile or readily leached are only effective for short periods of time. An effective preemergence herbicide must remain in the top one-half inch of the soil in sufficient concentration to inhibit the development of weed seedlings. This means that the chemicals should be somewhat immobile and stable so as to cover the entire period of weed seed germination.

One of the common misconceptions is that preemergence herbicides suppress germination. Actually, preemergence herbicides do not stop germination, but are phytotoxic to the newly developed weed seedlings. One of the newer chemicals (siduron) is so specific that it can be used in the seedbed to eliminate weed seedlings; however, it is not deleterious to the germinating turfgrass.

Proper Application

Herbicide placement is one of the most influential factors governing effectiveness. In the case of the preemergence materials, we want to create a seal in the top half inch of the soil. This can best be accomplished with the granular formulations which have shown more favorable results than either the emulsifiable concentrate or the wettable powders. It is important to make the application in at least two directions to insure uniform distribution.

Once the material has been applied, this seal should not be broken with any operation such as thatching or aeration which could bring untreated soil and weed seeds from a lower depth into the germination zone. Aeration should be accomplished in the spring prior to application of the chemical, or else delayed until after the period of weed seed germination in the fall.

In weed control, we have to discount the adage; "If a little bit is good, a whole lot is even better." Many serious problems have developed when this adage has been applied to selective weed control with herbicides.

Bensulide, DCPA and siduron all have shown effective crabgrass control. Studies also indicate that there appears to be no accumulation of these materials in soil receiving four annual applications. However, bensulide and siduron were shown to move downward in the soil profile after several weeks. Bensulide was found to persist in the soil several years from one application at the recommended rates.

Always Some Injury?

All of the preemergence crabgrass materials have been shown to cause some degree of injury to established turfgrass. In some cases injury was associated with only a particular grass or grass species, but in general they all suppressed the development of roots and stolons to some degree. Therefore, it is advisable to use herbicides only when necessary, and then never more than two years in succession.

Charcoal Cancelling

After applying a herbicide a situation often develops in which it becomes necessary to overseed. This could normally delay your operation anywhere from 12 to 16 weeks. It has been found that an application of 200 pounds of activated charcoal per acre during the seeding operation will nullify this residual effect of the herbicide.

Charcoal is available in many forms. It can be applied as a granular material, or the dust can be mixed with water and sprayed on the seedbed. In order to realize its full value the charcoal should be thoroughly incorporated into the seedbed by raking in at least two directions.

In conclusion, we must say that weeds are primarily a problem in those areas which lack good turfgrass coverage. As in the past, the most reliable weed control program is still one that concentrates on the maintenance of good turfgrass cover.

Where do all the seedies go? To my course, every one!

Low Temperatures and Poa Annua

by DR. JAMES B. BEARD, Michigan State University

Editór's note: In an earlier article, "Effect of Temperature Stress on Poa Annua," Green Section Record, July, 1968, Dr. James Beard pointed out the problems of high temperature stress on Poa annua. Here he covers the other side of the coin and brings us up to date on his oustanding studies of "Low Temperatures and Poa Annua."

As stated earlier, the actual temperature of a turfgrass plant or its individual parts is determined by its surrounding environment; i.e., the soil temperature for underground parts and the air temperature for above ground parts. The "optimum temperature" is that at which a particular plant process occurs at the highest rate. Optimum temperatures will vary depending upon the a) age of the plant, b) stage of development, c) specific plant organ involved, d) physiological condition of the plant, e) duration of the temperature level and f) variation in other environmental factors.

Low Temperature Stress

As temperatures are decreased below the optimum, there will eventually be a point at which growth will cease. However, respiration and photosynthesis have been found to occur in roots and shoots of turfgrasses at temperatures near 32 degress F. If temperatures continue to decrease, a point is reached where direct low temperature kill will occur. Research at Michigan State University shows that annual bluegrass is a turfgrass species which is relatively susceptible to low temperature kill compared to others, such as creeping bentgrass and Kentucky bluegrass (Figure 1).

The mechanism of direct low temperature kill involves mechanical disruption of the protoplasm caused by ice crystals. In general, the killing temperature increases with the hydration level or water content of the tissue. The relative low temperature tolerance of annual bluegrass will vary during the winter season. Maximum winter hardiness is achieved in late December, followed by a slight decrease in hardiness in late January, with a continued decrease in hardiness to a minimum level at the time of spring thaw. Therefore, low temperature kill is most likely to occur during the late winter, early spring freeze and thaw period when the crown tissues are at a higher hydration level.

It should be pointed out in relation to direct low temperature kill that the primary concern is the actual soil temperature rather than the air temperature. The critical tissues which must survive are the crown meristematic tissues. Leaf and root kill is of no concern since these tissues can be readily replaced by new growth from the crown. Thus, as long as temperatures in the crown area remain above the lethal level, no critical kill of the turf will occur.

Direct low temperature kill appears to be most common in an intermediate belt across Wisconsin, Michigan, New York, northern Illinois, and in certain areas of New England. This is an area that is subjected to extended periods of freezing and thawing and also has a higher potential for hydration of the crown tissues.

The comparative low temperature tolerance of annual bluegrass and Toronto creeping bentgrass is shown in test plants sampled in mid-December. (Figure 1).

Of more immediate concern to the professional turfman are methods to eliminate direct low temperature kill problems. Actually, there are no guaranteed methods of avoiding low temperature kill, but practices are available which will minimize the chance of injury. Detailed studies at Michigan State University show that excessive late fall nitrogen fertilization should be avoided because this will stimulate growth and increase the hydration level of the crown tissue. One should also be sure that adequate levels of potassium are present. It appears that a relationship of three to four units of nitrogen to one unit of potassium will provide the proper nutritional balance to insure maximum low temperature survival.

Other factors of concern are proper surface and internal soil drainage in order that free water can be drained from the vicinity of the crown tissue as rapidly as possible. If the annual bluegrass plants are permitted to stand in water for an extended period of time, the hydration level of the tissue will increase. If this is then followed by a very sharp freeze to temperatures of below 20 degrees F., the potential for direct low temperature kill is quite high. Thatch should also be avoided as it will contribute to increased low temperature kill. One final consideration is avoiding traffic over the turfgrass area during wet, slushy periods. If a sharp freeze occurs, this condition can result in severe turfgrass injury.

Ice and Snow Covers

Extended periods of ice and snow coverage sometime occur during winter period. The possibility exists that an extended period of high density ice coverage could impair gaseous diffusion to the point that the turf could be injured through either (a) suffocation caused by a lack of oxygen for respiration, or (b) toxic gases which have accumulated adjacent to the living tissues.

Both field and controlled climate studies have been conducted at Michigan State University to clarify this type of injury. Based on these studies, one must conclude that injury caused by the ice cover itself is a rare occurrence.

In general, most turfgrass species are relatively tolerant to extended periods of ice coverage. Annual bluegrass is less tolerant than many others. For example, injury to annual bluegrass may occur under ice sheets which have been in place in excess of 60-70 days. In contrast, bentgrass has survived as long as 120 days under an ice cover (Figure 2).

A demonstration of the comparative survival of Toronto creeping bentgrass, Kentucky bluegrass and annual bluegrass when they were completely sealed in ice for 120 days at 25° F. (Figure 2). Note kill of the annual bluegrass at right.

The question frequently arises, "Should I remove the ice and snow cover from my greens and tees?" Basically, this is a good practice, although the reason for which you may be removing it may not be the correct one. By removing a majority of the ice and snow from a green, you are essentially mechanically removing the water from the green in a frozen state. Thus, during the thawing period, this water will not accumulate in the vicinity of the grass crown tissue, cause an increase in the water content of the tissue, and result in a greater chance of injury due to low temperature kill. In general, one should not completely remove the ice and snow cover. It is best to leave between one-half and one-quarter inch of snow cover to avoid winter atmospheric desiccation problems which may occur if the turf is exposed to drying winds for extended periods of time.

In summary, annual bluegrass is relatively susceptible to both high temperature and low temperature stress, compared to many of the other permanent, perennial cool season turfgrasses being used. These are two reasons why annual bluegrass is objectionable in quality turfs. However, the prolific seed production and the presence of large quantities of Poa annua seed in the soil insures rapid reestablishment of a turfgrass stand following any temperature kill. Studies are continuing at Michigan State University in order better to understand high and low temperature stress mechanisms of turfgrass, with the ultimate hope of developing turfgrass species which have greater heat and cold tolerance.

When Poa Annua and cool season grasses fail in intense heat, bermudagrass is at its best, as evidenced by the trial strips in this fairway in the Transition Zone.

Bermudagrasses in the Transition Zone

by DR. ELWYN E. DEAL, Turf Specialist, University of Maryland

Problems? You bet we have them in the transition zone, probably better known as the "crabgrass belt."

We have one asset which in some cases might be a liability. We can grow most of the cool-season and most of the warm-season grasses (advantage), but none of them are well adapted to the area (disadvantage). Perhaps our greatest problem is that we spend too much time trying to grow all of them, when we should be concentrating on a select few.

The purpose of this article is not to promote bermudagrasses for fairways and tees, but rather to point out some of the advantages and disadvantages of using them.

First, the advantages.

When managed properly, bermudas are vigorous, fast-growing, deep-rooted grasses. They provide a dense, uniform, non-clumping turf that recovers quickly from injuries such as traffic, divots, etc. Even when dormant they provide a good playing surface.

Bermudas have their best growth during the hot summer months when most other fairway grasses are easily damaged. They can be cut close—down to ½ inch—which delights the golfers. During their growing season they are extremely tough competitors with weeds, and usually keep them under good control.

Bermudas respond well to good management, especially fertilization, and provide a beautiful playing surface throughout the late spring, summer and early fall months. Bermudas in this zone usually have few insect and disease problems. They are also very heat- and drought-tolerant. During dry periods they remain lush and green long after most other grasses have turned brown.

Two disadvantages weigh quite heavily against the bermudas: winter dormancy and winterkill. Along the northern limits for bermudas, this grass may be dormant, or partially so, for six or seven months of the year. Many golfers object to playing on brown turf, although most of those who have objected agree quite readily that the playing surface was perfectly satisfactory except for color.

Secondly, probably the most severe drawback for bermudas is the problem of winterkill. All varieties which are commercially available now lack sufficient winter hardiness to make them completely dependable. About once every five to ten years we have a very severe winter that takes out most of the bermudas. All of the winterkill problems cannot be attributed to lack of inherent winter hardiness, however. I am suspicious that after three or four successful years we become lax in managing these grasses.

We have known for many years now that a lush, tender grass is much more susceptible to winter injury than the same grass when it has had a chance to harden off before winter. Late fall fertilization with nitrogen, especially when there is an imbalance of nitrogen with phosphorus and potash, increases the likelihood of winter injury. We get by with it for two or three years and keep on using more nitrogen late in the year. Then we have a bad winter and lose the bermuda. Our natural reaction then is to blame it on the grasses.

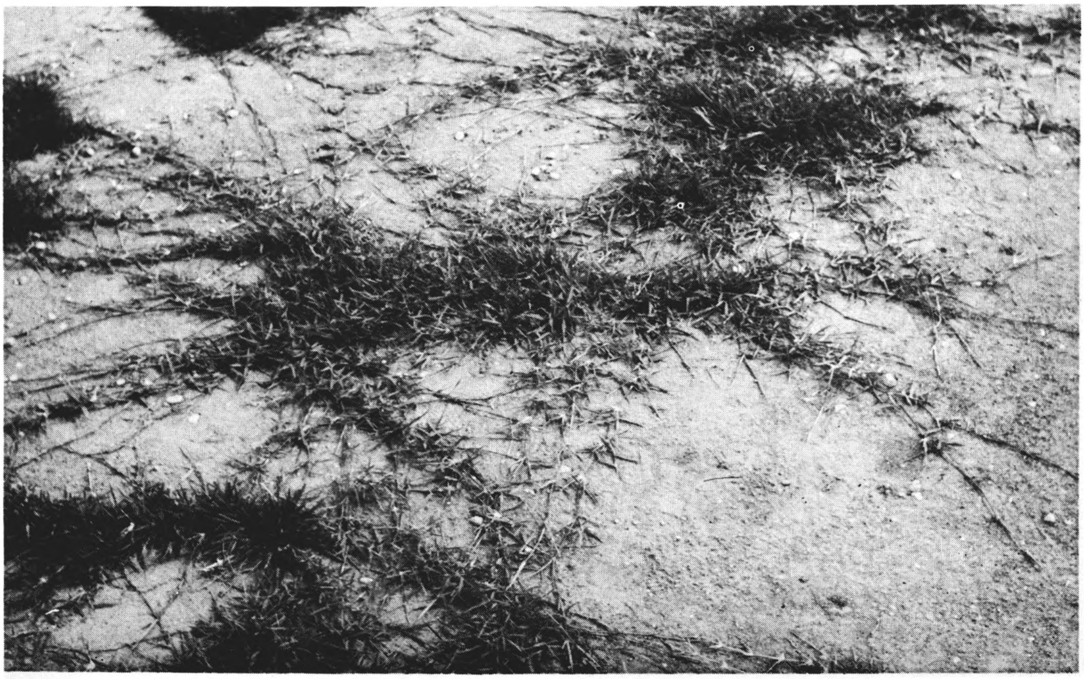
The bermudagrasses available today are not as winter-hardy as we would like to have them, but a lot can be done through good management to reduce the risk of winterkill. As indicated earlier, the fertilization program can easily be altered if necessary. Many golf course superintendents in the transition zone apparently fail to realize the drastically different type of management programs that are needed for the bermudas and for the cool-season grasses. Summer fertilization and thatch removal are two good examples.

One other problem that threatens bermudas is the "spring deadspot" disease. The real impact of this problem is difficult to evaluate in the transition zone because of the ups and downs in use of bermudas.

Another indirect threat, too, is the elaborate irrigation systems now available for golf courses. This, coupled with the development and use of sophisticated herbicides which control or prevent weed invasion, makes it easier to grow Kentucky bluegrasses on fairways.

Several new bermuda and Kentucky bluegrass selections are currently being evaluated which might help overcome some of the problems in the transition zone. Most of them need more study before we will know how much of a solution they will provide. If new Kentucky bluegrasses can be found which will tolerate close mowing ($\frac{3}{4}$ to 1 inch) and summer heat, they will likely receive the nod over bermudagrasses for most fairways in this zone because of their longer "green" season. Progress is being made with the winterhardiness problem in bermudas, but the one of long winter dormancy periods will likely be with us for a long time.

Bermudagrass spreads quickly to cover from stolons and rhizomes.



USGA GREEN SECTION RECORD
40 East 38th Street, New York, N. Y. 10016

TURF TWISTERS

NITROGEN VERSUS HAIR

Question: I was recently shown a list of the approximate nutrient content of waste materials and note that hair is from 8-16% nitrogen. Can this be used as fertilizer? (New Jersey)

Answer: Hair is used in making nitrogenous tankage and wet base goods. However, it is too slowly available to be suitable as a fertilizer. Hair may also be used in a compost to good advantage.

FERTIGATION VERSUS DRY FERTILIZER

Question: What are some of the pros and cons of applying fertilizers through the irrigation system? (California)

Answer: We have seen this practice on a number of golf courses over the years. Yet one of the main problems with this technique lies in the fact that it is only as effective as the irrigation system, and most golf course irrigation systems are incapable of uniform coverage. Irrigation patterns are distorted by the wind, water pressure differences, sprinkler head efficiency, fixed objects such as trees or shrubs, etc.

Other problems that have been encountered in the past include terrain unevenness and runoff, different fertilizer requirements for different areas (tees, greens, fairways, roughs, etc.), and corrosion of metal parts in the irrigation system. Finally, there are some who believe that constant "force feeding" of turfgrasses does not always produce the best golfing turf.

Fertigation has been successful in many areas of agriculture. On golf courses, it has yet to prove its long range advantages over dry fertilizer application.

RYEGRASS VERSUS THE CIVIL WAR

Question: By the end of this season, our practice tee looked as if the Civil War was fought over it. Is there any way to grow grass on a medium to small size practice tee? We have no room for expansion. (Nevada)

Answer: Grass won't grow on a busy street. However, there may be a way to alleviate the problem. Reasonable success has been achieved by overseeding tees every month of the growing season with annual ryegrass. About 20 pounds per 1000 square feet is suggested. It is inexpensive, quick to germinate and at least gives some grass cover until that next divot is taken.